

【DESCRIPTION】

【Invention Title】

AUGMENTED REALITY-BASED PIPE WELDING POINT
MANAGEMENT METHOD

【Technical Field】

[1] The present invention relates to an augmented reality-based pipe welding point management method, and more particularly to an augmented reality-based pipe welding point management method using a welding point management application installed on a mobile device for efficient management of welding points.

【Background Art】

[2] Generally, high-tech industries refer to highly technology-intensive industries with significant effects on related industries, for example, advanced technology-intensive industries centered on cutting-edge technologies such as electronics, new materials, biotechnology, computers, and information and communications. When constructing facilities for such high-tech industries, numerous pipes and cables are installed. For example, constructing a semiconductor production line necessitates the installation of gas pipes, chemical pipes, electrical cables, and fire

protection pipes for equipment performing various processes. In the construction of the semiconductor production line, various applications are known to enable a worker to register the construction state of the pipes and other members and to allow a client to clearly understand the same. Using augmented reality (AR) to register and modify construction performance is also one of such methods.

[3] Augmented reality (AR) refers to a technology that adds computer-generated information to any of the five senses experienced by a user in the real world, i.e., a technology that overlays virtual objects (virtual reality) onto the real world shown to the user's eyes. Unlike virtual reality, which constructs reality only in a computer, augmented reality refers to overlaying virtual information onto the real world.

[4] A method of facilitating management at a plant construction site or an interior construction site using such augmented reality is disclosed in Korean Registered Patent No. 10-2462229 (registered on October 28, 2022). Conventional approaches using augmented reality to manage construction sites or register or modify construction performance, including the above conventional method, have several problems. That is, particularly when fire protection pipes, gas pipes, chemical pipes, and

electrical cables are located on the ceilings at a construction site, in order to implement augmented reality by matching virtual reality with actual reality sensed by a camera equipped in a mobile device (e.g., a tablet computer), touch, drag, and information input must be performed using one hand while the mobile device is held using the other hand. The weight of the mobile device makes it difficult to perform tasks beyond very short periods while holding the mobile device with one hand. Furthermore, in constructing facilities for high-tech industries, the fire protection pipes, the gas pipes, the chemical pipes, and the electrical cables are extremely long, heavy, and are connected to each other by welding during installation. Augmented reality is needed to enhance efficiency and convenience in verifying and managing a plurality of welding points.

【Disclosure】

【Technical Problem】

[5] In constructing facilities for high-tech industries, fire protection pipes, gas pipes, chemical pipes, and electrical cables are extremely long, heavy, and are connected to each other by welding during installation, and therefore it is an object of the present invention to provide an improved augmented

reality-based pipe welding point management method that enables efficient management of welding points.

[6] Conventional methods of managing construction sites using augmented reality through a mobile device have problems in that the weight of the mobile device makes it difficult to perform tasks beyond very short periods while holding the mobile device with one hand and in that the frequency of designation errors is high when using one hand to hold the mobile device while performing tasks with the other, resulting in reduced work accuracy, disrupted workflow, or delayed progress, and it is another object of the present invention to provide an improved augmented reality-based pipe welding point management method that is capable of solving the above problems.

【Technical Solution】

[7] A pipe welding point management method according to an aspect of the present invention to achieve the above objects, which is an augmented reality-based pipe welding point management method using a mobile device having a welding point management application installed thereon and equipped with a camera configured to capture an image of a management target, includes (a) executing the welding point management application to match actual

reality of a pipe construction site being captured by the camera with virtual reality related to the pipe construction site, thereby implementing augmented reality related to the pipe construction site so as to be displayed through the mobile device, a welding point generation bar being further displayed on a screen of the mobile device in addition to the augmented reality related to the pipe construction site, the welding point generation bar being scaled down so as to correspond to the management target implemented as the augmented reality related to the pipe construction site, (b) activating the management target by displaying the management target as a virtual line when there is a primary touch input by a user of the mobile device for selecting the management target in order to manage a welding point in the augmented reality related to the pipe construction site, (c) generating a reference welding point at a secondary touch input point when there is a secondary touch input by the user of the mobile device on the welding point generation bar in order to apply the welding point to the management target by the user of the mobile device, and (d) generating and displaying a virtual welding line is at a point on the management target implemented as the augmented reality related to the pipe construction site corresponding to

the reference welding point generated at the secondary touch input point.

[8] In an embodiment, the management target may be any one of a gas pipe, a fire protection pipe, a chemical pipe, and an electrical cable.

[9] In an embodiment, a length adjustment button configured to adjust the length of the welding point generation bar may be further displayed on the screen of the mobile device.

[10] In an embodiment, when the reference welding point generated in step (c) is provided in plural, step (d) may include generating and displaying virtual welding lines at points on the management target implemented as the augmented reality related to the pipe construction site so as to correspond to the plurality of reference welding points, respectively.

[11] In an embodiment, the plurality of reference welding points is generated so as to correspond respectively to a plurality of secondary touch inputs by the user of the mobile device on the welding point generation bar.

[12] In an embodiment, the plurality of reference welding points may be formed at equal intervals according to interval information input by the user of the mobile device.

[13] In an embodiment, the plurality of reference welding points may be formed at equal intervals according to quantity information input by the user of the mobile device.

【Advantageous Effects】

[14] The present invention has the effect of enabling more efficient management of welding points for various pipes in the construction of facilities for high-tech industries by the provision of an improved augmented reality-based pipe welding point management method. In addition, the present invention has the effect of solving problems of conventional methods of managing construction sites using augmented reality through a mobile device in that the weight of the mobile device makes it difficult to perform tasks beyond very short periods while holding the mobile device with one hand and in that the frequency of designation errors is high when using one hand to hold the mobile device while performing tasks with the other, resulting in reduced work accuracy, disrupted workflow, or delayed progress, by the provision of the improved augmented reality-based pipe welding point management method.

【Description of Drawings】

[15] FIG. 1 is a view illustrating a mobile device 1 used for an augmented reality-based pipe welding point management method according to an embodiment of the present invention and the display state of the mobile device 1 in the state in which a welding point management application is executed on the mobile device 1;

[16] FIGs. 2A and 2B are views showing an example of augmented reality for pipe welding point management;

[17] FIG. 3 is a view describing a single selection mode after generating reference welding point(s);

[18] FIGs. 4A and 4B are views describing a multiple selection mode after generating the reference welding points;

[19] FIG. 5 is a view describing an example of a division mode;

[20] FIGs. 6A and 6B are views describing another example of the division mode; and

[21] FIGs. 7A and 7B are views describing a length adjustment button 111 for adjusting the length of a welding point generation bar 110.

[22]

【Best Mode】

[23] The present invention provides a method of enhancing work efficiency by utilizing a welding point management application in augmented reality installed on

a mobile device during the construction of facilities for high-tech industries, as mentioned above.

[24] Hereinafter, preferred embodiments of the present invention will be described with reference to the accompanying drawings. It should be noted that the accompanying drawings and the embodiments are simplified and illustrated for the purpose of aiding those skilled in the art to understand the present invention. In the present invention, a management target may be any one of a gas pipe, a fire protection pipe, a chemical pipe, and an electrical cable required during the construction of facilities for high-tech industries. Furthermore, the term "management" as used herein in relation to welding points refers to the entire series of work processes associated with welding points, such as generating welding points (welding points in virtual reality) about a plurality of welding points on the management target, comparing the positions of the welding points with the positions of actual welding points using augmented reality, modifying the positions of the welding points in virtual reality, registering the results thereof, and monitoring the welding points.

[25] FIG. 1 is a view illustrating a mobile device 1 used for an augmented reality-based pipe welding point management method according to an embodiment of the

present invention and the display state of the mobile device 1 in the state in which a welding point management application is executed on the mobile device 1, FIGs. 2A and 2B are views showing an example of augmented reality for pipe welding point management, FIG. 3 is a view describing a single selection mode after generating reference welding point(s), FIGs. 4A and 4B are views describing a multiple selection mode after generating the reference welding points, FIG. 5 is a view describing an example of a division mode, FIGs. 6A and 6B are views describing another example of the division mode, and FIGs. 7A and 7B are views describing a length adjustment button 111 for adjusting the length of a welding point generation bar 110.

[26] First, referring to FIG. 1, a tablet computer is shown as an example of the mobile device 1, but the mobile device may be a smartphone or a dedicated computing device for implementing augmented reality, in addition to the tablet computer. The mobile device 1 has a welding point management application installed thereon, and is equipped with a camera for capturing images of a welding point management target (hereinafter referred to simply as a management target or a member). The mobile device 1 fundamentally includes a processing unit and a memory, in addition to the camera, and detailed

descriptions of the fundamental components will be omitted. When the welding point management application installed on the mobile device 1 is executed, various buttons may be displayed on a screen 2 so as to allow a user of the mobile device 1 to operate the welding point management application by scrolling or touching with a finger. In FIG. 1(b), a component indicated by reference symbol RE1 is an example of the welding point management target, i.e., the management target, and reference numeral 110 denotes a welding point generation bar, which is a core user interface of the present invention. The welding point generation bar 110 is an additional element other than augmented reality related to a pipe construction site displayed on the screen 2 of the mobile device 1. The welding point generation bar is scaled down so as to correspond to the management target implemented as augmented reality related to the pipe construction site, and the reference welding point(s) are generated and displayed based on touch input by the user (worker) of the mobile device 1 through the welding point generation bar 110. The welding point generation bar 110 will be described in more detail later.

[27] In the augmented reality-based pipe welding point management method using the mobile device 1 according to the embodiment of the present invention, the mobile

device 1 basically has a welding point management application installed thereon to implement augmented reality, and is equipped with a camera (not shown) for capturing images of the management target. First, the augmented reality-based pipe welding point management method using the mobile device 1 according to the embodiment of the present invention includes a step of executing the welding point management application to match actual reality of the pipe construction site being captured by the camera with virtual reality related to the pipe construction site, thereby implementing augmented reality related to the pipe construction site so as to be displayed on the screen of the mobile device. In addition to the augmented reality related to the pipe construction site, the welding point generation bar 110 is further displayed on the screen of the mobile device. As mentioned above, the welding point generation bar 110 is scaled down so as to correspond to the management target RE1 implemented as the augmented reality related to the pipe construction site. Next, the augmented reality-based pipe welding point management method includes a step of activating the management target by displaying the management target as a virtual line (see an outer line of RE1 in FIG. 2A) when the user of the mobile device 1 touches the management target in order to

manage a welding point in the augmented reality related to the pipe construction site, i.e., when there is a primary touch input by the user for selecting the management target. The management target RE1 and the welding point generation bar 110 are linked to each other by the primary touch input. Specifically, when there is a secondary touch input by the user of the mobile device 1 on the welding point generation bar 110 in order to apply the welding point to the management target by the user of the mobile device 1, a reference welding point is generated and displayed at a secondary touch input point. The reference welding points are denoted by L1, L11, L12, L13... in subsequent figures. That is, the user of the mobile device 1 generates the reference welding point(s) at appropriate positions on the welding point generation bar 110. Since the welding point generation bar 110 and the management target RE1 are linked to each other, a virtual welding line is generated and displayed at the point on the management target RE1 implemented as the augmented reality related to the pipe construction site, corresponding to the reference welding point generated at the secondary touch input point by the user, on the screen of the mobile device 1. The virtual welding lines are denoted by VL1, VL11, VL12, VL13, ... in subsequent figures. If a plurality of reference welding points is

to be generated, points on the management target implemented as augmented reality may be generated so as to correspond to the position of each of the plurality of reference welding points, and may be displayed in the augmented reality. The plurality of reference welding points may be generated so as to correspond respectively to a plurality of secondary touch inputs by the user of the mobile device 1 on the welding point generation bar 110, or alternatively, the plurality of reference welding points may be generated according to various division modes described later.

[28] FIGs. 2A and 2B are views showing an example of augmented reality for pipe welding point management. Referring to FIGs. 2A and 2B together with FIG. 1, the reference welding point(s) may be generated by touching (secondary touch input) the welding point generation bar 110 located at the center of the screen 2 of the mobile device 1 after selecting the member to which the welding point is to be applied, i.e., the management target RE11. That is, as shown in FIG. 2A, when the user of the mobile device 1 performs a secondary touch input at an appropriate position on the welding point generation bar 110 in the initial state in which no reference welding points are displayed on the welding point generation bar 110, a reference welding point L1 is generated at that

position so as to correspond thereto. As shown in FIG. 2B, only one reference welding point is denoted by L1 for convenience, although a plurality of reference welding points L1 may be generated by the user's manipulation. In addition, a virtual welding line VL1 is generated and displayed at a corresponding position on the management target RE11 so as to correspond to the reference welding point L1. Although not shown in FIG. 2A, each of the plurality of reference welding points generated on the welding point generation bar 110 matches a corresponding one of the virtual welding lines displayed on the management target RE11. In the state in which the virtual welding lines are displayed on the management target RE11, as described above, the positions of the virtual welding lines are compared with the positions of the actual welding points, whereby it is possible to track and monitor the number and accurate positions of the welding points. Reference numeral 120 in FIG. 2B denotes a delete button, which is displayed as a "e" shape under each of the reference welding points. The user may delete the reference welding point by touching the delete button 120. In addition, although not shown in the figures, a transparency adjustment button may be added to compare the positions of the actual welding points with the positions of welding points to be

registered, i.e., the virtual welding lines VL1. That is, the transparency of the management target implemented as virtual reality may be increased so as to allow the actual welding points to be visible through augmented reality by touching the transparency adjustment button, whereby it is possible to finely adjust the welding points to be registered while comparing whether the actual welding points match the welding points applied in the virtual reality, i.e., the virtual welding lines VL1. Reference numeral 140 denotes a left and right arrow button used to designate a specific reference welding point in the state in which the plurality of reference welding points is generated on the welding point generation bar 110. Pressing the left arrow designates the reference welding point located to the left of the current reference welding point, and pressing the right arrow designates the reference welding point located to the right of the current reference welding point. Reference numeral 160 denotes a position shift button for shifting the position of the selected reference welding point. The use of the position shift button 160 will be described below with reference to FIGs. 4A and 4B.

[29] FIG. 3 is a view describing a single selection mode after generating the reference welding point(s). The single selection mode is a mode for selecting one

reference welding point and changing the position of the reference welding point or deleting the reference welding point. Referring to FIG. 3, when a single selection button 150 is touched by the user of the mobile device after the plurality of reference welding points L11, L12, L13, and L14 is generated on the welding point generation bar 110, switching to the state in which only one of the reference welding points L11, L12, L13, and L14 can be selected is performed. For example, if L14 is touched to designate L14 and then L13 is touched again, switching to the state in which L13 is designated is performed. In addition, the position of the designated reference welding point may be changed by touching the left and right arrow button 140. For example, when the left and right arrow button 140 is touched once in the state in which the reference welding point L13 is selected, L13 is designated, and when the left and right arrow button 140 is touched twice in the state in which the reference welding point is selected, L11 is designated. Reference symbols VL11, VL12, VL13, and VL14 denote virtual welding lines displayed on the management target RE21 corresponding to L11, L12, L13, and L14, respectively.

[30] FIGS. 4A and 4B are views describing a multiple selection mode after generating the reference welding points L21, L22, and L23 on the welding point generation

bar 110. The multiple selection mode is a mode for selecting a plurality of reference welding points. As shown in FIGs. 4A and 4B, when a multiple selection button 170 is touched by the user of the mobile device after a plurality of reference welding points L21, L22, and L23 is generated on the welding point generation bar 110, a plurality of reference welding points may be selected from among the reference welding points L21, L22, and L23. For example, in FIG. 4A, when the position shift button 160 is dragged to the right in the state in which two reference welding points L21 and L22 are selected from among the reference welding points L21, L22, and L23, the two reference welding points L21 and L22 are simultaneously shifted to the right (L21' and L22' in FIG. 4B). Correspondingly, virtual welding lines VL21 and VL22 on the management target RE31 corresponding thereto also move to the right (VL21' and VL22' in FIG. 4B). VL21, VL22, VL23, VL21', and VL22' are virtual welding lines corresponding to the virtual welding lines L21, L22, L23, L21', and L22', respectively. In this case, the left and right arrow button 140 may be used to increase or decrease the number of selected reference welding points. That is, when the right arrow of the left and right arrow button 140 is touched once in the state in which L21 is selected, L21 and L22 are simultaneously

selected. When the right arrow is touched once again, L21, L22, and L23 are all selected. When the left arrow is touched once in this state, L23 is deselected, and when the left arrow is touched once again, L22 is also deselected.

[31] FIG. 5 is a view describing an example of a division mode. The illustrated division mode is a quantity-based division mode, which is a mode for dividing the welding point generation bar 110 into n parts at equal intervals. When the user of the mobile device inputs the desired number of divided parts into a quantity information input window denoted by reference numeral 180, reference welding points are generated to automatically calculate the total length of the selected member, i.e. the management target RE31, and to divide the management target into n parts at equal intervals. At the same time, virtual welding lines corresponding to the reference welding points are displayed on the management target RE31. In FIG. 5, only one of the plurality of reference welding points is shown while being denoted by reference symbol L31, and only one VL31 of the plurality of virtual welding lines corresponding to L31 is shown.

[32] FIGs. 6A and 6B are views describing another example of the division mode. The illustrated division

mode is an interval-based division mode. As shown in FIG. 6A, an equal interval button denoted by reference numeral 190 is selected, and interval information to be divided is input into an interval input window 191. When one flag welding point L41 is generated on the welding point generation bar 110 and a direction selection arrow 192 is touched to select the direction in which the welding point generation bar is to be divided, the welding point generation bar 110 is divided according to the interval information entered into the interval input window 191, and correspondingly the management target RE41 is also divided, as shown in FIG. 6B. That is, reference welding points L42, L43, and L44 are generated on the welding point generation bar 110, and correspondingly virtual welding lines VL42, VL43, and VL44 are also generated on the management target RE41. Conversely, in order to divide the welding point generation bar in a right direction, an arrow (reference symbol not shown) located to the right of the flag welding point L41 may be touched.

[33] FIGs. 7A and 7B are views describing a length adjustment button 111 for adjusting the length of the welding point generation bar 110. As shown in FIGs. 7A and 7B, the length adjustment button for adjusting the length of the welding point generation bar 110 may be further displayed on the screen of the mobile device. In

the figures, the length adjustment button 111 is shown as being located at the rightmost end of the welding point generation bar 110, but the length adjustment button may be located on the opposite side. When the user drags the length adjustment button 111 to the left in the state in which the length of the welding point generation bar 110 is increased, as shown in FIG. 7A, the length of the welding point generation bar 110 decreases, as shown in FIG. 7B. Conversely, when the user drags the length adjustment button 111 to the right in the state in which the length of the welding point generation bar 110 is decreased, as shown in FIG. 7B, the length of the welding point generation bar 110 increases, as shown in FIG. 7A.

[34] The pipe welding point management method using the mobile device according to the embodiment of the present invention has been described in the above, and it is expected that the management of welding points of various pipes in the construction of facilities for high-tech industries can be conducted more efficiently by utilizing the augmented reality-based pipe welding point management method according to the present invention.

[35] It should be noted that the scope of the present invention is defined not by the above description but by the appended claims below.

【CLAIMS】

【Claim 1】 An augmented reality-based pipe welding point management method using a mobile device having a welding point management application installed thereon and equipped with a camera configured to capture an image of a management target, the augmented reality-based pipe welding point management method comprising:

(a) executing the welding point management application to match actual reality of a pipe construction site being captured by the camera with virtual reality related to the pipe construction site, thereby implementing augmented reality related to the pipe construction site so as to be displayed through the mobile device, a welding point generation bar being further displayed on a screen of the mobile device in addition to the augmented reality related to the pipe construction site, the welding point generation bar being scaled down so as to correspond to the management target implemented as the augmented reality related to the pipe construction site;

(b) activating the management target by displaying the management target as a virtual line when there is a primary touch input by a user of the mobile device for selecting the management target in order to manage a

welding point in the augmented reality related to the pipe construction site;

(c) generating a reference welding point at a secondary touch input point when there is a secondary touch input by the user of the mobile device on the welding point generation bar in order to apply the welding point to the management target by the user of the mobile device; and

(d) generating and displaying a virtual welding line is at a point on the management target implemented as the augmented reality related to the pipe construction site corresponding to the reference welding point generated at the secondary touch input point.

【Claim 2】 The augmented reality-based pipe welding point management method according to claim 1, wherein the management target is any one of a gas pipe, a fire protection pipe, a chemical pipe, and an electrical cable.

【Claim 3】 The augmented reality-based pipe welding point management method according to claim 1, wherein a length adjustment button configured to adjust a length of the welding point generation bar is further displayed on the screen of the mobile device.

【Claim 4】 The augmented reality-based pipe welding point management method according to claim 1, wherein, when the reference welding point generated in step (c) is provided in plural, step (d) comprises generating and displaying virtual welding lines at points on the management target implemented as the augmented reality related to the pipe construction site so as to correspond to the plurality of reference welding points, respectively.

【Claim 5】 The augmented reality-based pipe welding point management method according to claim 4, wherein the plurality of reference welding points is generated so as to correspond respectively to a plurality of secondary touch inputs by the user of the mobile device on the welding point generation bar.

【Claim 6】 The augmented reality-based pipe welding point management method according to claim 4, wherein the plurality of reference welding points is formed at equal intervals according to interval information input by the user of the mobile device.

【Claim 7】 The augmented reality-based pipe welding point management method according to claim 4, wherein the

plurality of reference welding points is formed at equal intervals according to quantity information input by the user of the mobile device.